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DECLARATION

The undersigned, Olaf Bexhoeft, hereby states that he is well acquainted with both the English and German languages and that the attached is a true translation to the best of his knowledge and ability of the German text of PCT/EP2005/003694, filed 04/08/2005, and published on 10/27/2005 as WO 2005/101939 A1.

The undersigned further declares that the above statement is true; and further, that this statement was made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or document or any patent resulting therefrom.

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Mounting Plate for Electronic Components

The invention relates to a mounting plate for electronic components, in particular with cooling conduits integrated in a plate body for a cooling medium to flow through, wherein a fastening arrangement for mounting the electronic components is arranged on the plate body.

It is known from the prior art (without proof in the form of publications) to insert cooling coils into a mounting plate or mounting board made of aluminum, in order to cool electronic devices, for example frequency converters, which are to be mounted on the mounting plate. The waste heat from the electronic components can be carried off by means of such a "cold plate".

The electronic components can be maintained on such a known mounting plate by means of screw connections. For this purpose, screw holes are provided in the housings of the electronic components, through which a screw can be turned into threaded holes to be cut into the mounting plate. Because of the cooling coils, however, holes cannot be drilled without danger of damage to the known mounting plates. Moreover, the electronic components often have different dimensions, so that different fastening dimensions also exist. Thus, it is often not possible to provide the mounting plate with a predetermined grid of threaded holes, since the threaded holes applied to the housings of the electronic components are not aligned with them.

In known mounting plates of the firm PADA Engineering, the cooling coils are mounted visibly on the plate surface in order to prevent accidental damage of the cooling conduits to

the greatest extent in the course of later mechanical working of the mounting plate.

However, it is necessary in connection with the known mounting plates to cut specially arranged threaded holes, depending on the fastening dimensions of the electronic component to be mounted. This requires elaborate fastening techniques.

Also, based on the mounting areas on the mounting plate predetermined by the position of the cooling coils, the component density of several electronic components to be mounted is reduced since, because of the guidance of the coolant conduits, not every position is suitable for cutting a threaded hole.

In is the object of the invention to disclose a mounting plate for electronic components which, along with a reduced mounting outlay and secure holding of the electronic components to be mounted, offers variable arrangement options on the plate surface without drilling holes into it.

This object of the invention is attained by means of the characteristics of claim 1. Advantageous further developments are respectively described in the dependent claims.

Accordingly, the fastening arrangement has at least one holding element with a fastening screw thread and at least one first groove or rib, which is embodied to be undercut, extends in a straight line in the extension direction of the mounting plate, and into which the at least one holding element can be inserted for fixing the component in place. The additional cutting of threaded holes is avoided by this arrangement. Mounting can be accomplished in a simple manner wherein, because of the freely selectable positioning of the

holding elements in the groove, the adaptation to the structural conditions of the components is possible.

In accordance with a further basic concept, the fastening arrangement can have at least one second groove or rib, which is embodied in the same way as the first groove or rib and extends parallel in respect to the first groove or rib, whose distance from the first groove or rib is substantially determined by the length of extension of the electronic component to be mounted, which runs perpendicularly in respect to the first or second groove or rib. In this way it is assured that, with a preset fastening size of electronic components to be mounted, a simple securing on the mounting plate can take place.

In accordance with an advantageous further embodiment, the fastening arrangement can have at least one further groove or rib extending parallel with the second groove or rib, which is embodied in the same way as the first groove or rib and the second groove or rib, which extends along the side of the second groove or rib facing away from the electronic component to be mounted at a distance from it, which is less than the distance between the first groove or rib and the second groove or rib. By means of this arrangement consideration is given to an additionally used further fastening dimension of electronic components to be mounted.

Electronic components having holes for fastening by means of screws can be mounted in a simple manner. In this case the electronic components can be fastened by means of screws directly on the holding elements inserted into the grooves or ribs, or can be fixed in place by means of strip-like holding elements attached indirectly or directly to the

holding elements.

However, if the fastening dimensions of the electronic compounds to be mounted do not agree with the spacing between the parallel extending grooves, i.e. if the electronic components to be mounted have holes whose spacing between each other is less than the distance between the second groove and the first groove, or less than the distance of the still further groove from the first groove, the component can be fixed in place at least on one side by an angled sheet metal piece, wherein at least one screw engaging the angled sheet metal piece is screwed into the holding element inserted into the corresponding groove.

Here, the angled sheet metal piece can have a flat base plate for placement against the mounting plate and a clamping area, which is angled in respect to it, for the clamping fixation of the electronic component to be mounted. In the course of this, the clamping area can clampingly engage a protrusion provided on the electronic component.

In order to achieve a particularly simple adaptation to different structural dimensions of electronic components to be mounted, the angled sheet metal piece can have at least one elongated hole, which extends perpendicularly in respect to the direction of extension of the second groove or the still further groove, for receiving the screw.

In an advantageous embodiment, the holding element can be a spring nut.

In view of manufacturing technology it is advantageous if the first groove, the second groove and/or the still further groove are embodied in one piece with the plate body.

Improved arrangement and fastening possibilities result if at least one holding element is embodied as a groove

insert, which has a base part which can be inserted into one of the grooves, and a top part protruding from the groove if, in the inserted state of the groove insert, the top part has a fastening section spaced apart from the mounting level of the mounting plate, which can be positioned above a base part to be located under it, of the component to be fixed in place, wherein the distance of the fastening section is greater than the thickness of the base part in the direction of the normal line in respect to the mounting level, and that at least one threaded bore is provided in the fastening section, into which an attachment screw, which works together with the base part, can be screwed for fixing the component in place.

Furthermore, those steps contribute to simple secure mounting, wherein at least one holding element is made as a sliding block with a base part which can be pushed into one of the grooves, and with a top part protruding from the groove, and that a threaded bore is arranged in the top part in the direction of the normal line in respect to the mounting level, on which a holding means for the component can be screwed in place.

Variable fastening possibilities are favored in that the fastening arrangement has at least one holding strip, which can be arranged transversely in respect to the grooves and is dimensioned in such a way that it spans the distance between two grooves and can be fixed in place by means of threaded bores in its end sections on both sides in the sliding blocks and/or groove inserts pushed into the respective grooves.

An intended arrangement at practically any desired location of the mounting level without additional bores is

made possible in that at least one strip-like bridge is provided, which can be displaceably inserted at a distance from the mounting level between two holding strips, which are arranged on both sides of a component parallel in respect to each other, and has bores, by means of which the component can be fixed in place at its base by means of at least one attachment screw.

Here, those steps contribute to simple mounting, wherein the bridge has open slits in both its end sections in the direction toward the holding strips, by means of which it is displaceably held on the holding strips.

The arrangement and fastening possibilities are aided in that the at least one holding strip and/or bridge is provided with a row of threaded bores or fastening holes.

The stability of the fastening arrangement is aided in that the holding strip and/or the bridge is designed in an angular shape in cross section, or is provided with at least one reinforcement rib.

The invention will be explained in greater detail in what follows by means of preferred exemplary embodiments while making reference to the drawings. Shown are in:

Fig. 1, a mounting plate in a schematic and perspective lateral view without electronic components which are to be mounted on it and to be cooled,

Fig. 2, an angled sheet metal piece in a schematic and perspective lateral view for mounting which can be matched to different fastening dimensions of electronic components to be mounted,

Fig. 3, the mounting plate in accordance with Fig. 1 in a schematic and perspective lateral view with frequency converters which are to be cooled mounted thereon, each of

which is clampingly held on one side by means of an angle iron in accordance with Fig. 2,

Fig. 4 different elements of a fastening arrangement in partial views a) to d),

Fig. 5, a mounting arrangement from above in a schematic plan view with a mounting plate, a component to be fastened, and the elements of the fastening arrangement in accordance with Fig. 4,

Fig. 6, a perspective plan view of the arrangement in accordance with Fig. 5 from one side, and

Fig. 7, a perspective plan view of the arrangement in accordance with Fig. 5 from an opposite side in respect to Fig. 6.

In a schematic and perspective lateral view, Fig. 1 shows a mounting plate 10 without electronic components which are to be mounted on it and to be cooled. The mounting plate 10 has a flat plate body 14 made, for example, of aluminum, in which a cooling circuit is embodied with connectors 16 and 18 in the form of a cooling coil, which cannot be seen, for the flow-through of a cooling fluid. In the area in which the cooling fluid coil is integrally deployed, the plate body 14 is not additionally processed, but instead is designed to be flat and level. On the side to the right in Fig. 1 of the area in which the cooling fluid coil is integrally placed, an undercut first groove 20 is formed in one piece with the plate body, which is approximately C-shaped in cross section and extends in a straight line in the direction (arrow A) of extension of the mounting plate 14. At least one holding element, for example a spring nut (not represented), a sliding block 25 (Fig. 4a), and/or a groove insert (Fig. 4b) for providing a screw connection with an electronic component

12, or further elements of a fastening arrangement, can be inserted, preferably fixed against relative rotation, into the first groove 20. The electronic components to be installed can then be securely fixed in suitable positions.

Parallel with the first groove 20, an undercut second groove 22 extends at the side of the area of the plate body on the left in Fig. 1, in which the cooling coil is integrally deposited. The distance between the first groove 20 and the second groove is defined, on the one hand, by the area of the plate body in which the cooling coil has been integrally deposited, and on the other hand by the length of extension perpendicularly in respect to the first groove 20 and the second groove 22 of an electronic component to be mounted.

An undercut further groove 24 extends parallel with the first groove 20 and the second groove 22, which extends at a distance C in respect to a side 26 of the second groove facing away from the component to be mounted. The distance C is less than the distance B between the first groove 20 and the second groove 22, and is matched to a different fastening dimension than is the case with the second groove 22.

Electronic components to be mounted, whose enclosures or housings have screw holes whose distance from each other corresponds to the distance B of the second groove 22 from the first groove 20, or of the still further groove 24 from the first groove 20, can be directly fastened by screws on nuts inserted into the grooves 20, 22, 24.

In a schematic and perspective lateral view, Fig. 2 shows an angled sheet metal piece 30 for mounting, which can be matched to different fastening dimensions of electronic components to be mounted.

Electronic components to be mounted, whose housings have screw holes whose distance from each other is less than the distance B (represented in Fig. 1) of the first groove 20 from the second groove 22, or less than the distance of the still further groove 24 from the first groove 20, can be clampingly fixed in place at least on one side through the angled sheet metal piece 30 by means of a screw (not represented) engaging the piece on screw nuts introduced into the appropriate groove 22.

The angled sheet metal piece 30 has a flat base plate 34 for placement against the mounting plate 10, and a clamping area 36 angled in respect to it and made of one piece for the clamping fixation of the electronic component to be mounted.

The angled sheet metal piece 30 has two elongated holes 38 and 39, which run perpendicularly (arrow D) in respect to the extension direction (arrow A) of the second groove 22, or the still further groove 24, for receiving a screw (not represented).

In a schematic and perspective lateral view, Fig. 3 shows the mounting plate 10 in accordance with Fig. 1 with frequency converters 12, which are to be cooled, mounted thereon, each of which is clampingly held on one side by an angled sheet metal piece 30 in accordance with Fig. 2.

The frequency converters whose extension B does not match the distance between the two grooves 20 and 22 are each screwed together on the right side in Fig. 3 by means of screws, which engage spring nuts (not represented) inserted into the groove 20. Such a screw has been given the reference numeral 28 in Fig. 3.

On the left side in Fig. 3, the frequency converters 12

are each clamped by means of an additional angled sheet metal piece, one of which is represented by the reference numeral 30. For example, in the elongated hole 38 of the represented angled sheet metal piece 30, a screw 32 engages a spring nut (not represented) introduced into the second groove 22. The angled sheet metal piece 30 clampingly engages a protrusion 13 on the housing of the frequency converter 12. The fastening dimension, which does not fit the spacing between the grooves, is compensated by the fastening through the elongated hole.

In the partial views a) to d), Fig. 4 shows different elements of a fastening arrangement, namely a sliding block 25 (partial view a)), a groove insert 26 (partial view b)), a holding strip (partial view c)), and a strip-like bridge 28 (partial vied d)), which may be provided in greater or lesser numbers for forming a kit, so that it is possible to fix components of different dimensions and/or in different positions in place on the mounting level of the mounting plate 10. The mounting principle here ensues from Figs. 5, 6 and 7. No fastening bores are required in the mounting plate.

As can be seen in Fig. 4 a), for insertion into a groove 20, 22, 24 which is T-shaped in cross section, the sliding block 25 has a T-shaped base section 25.1 matched to the groove cross section, as well as a top section 25.2 extending from the groove past the mounting level, into whose top a threaded bore 25.3 has been cut in the direction of the normal line in respect to the mounting level. Also possible are lateral threaded bores parallel with the mounting level. The sliding block 25 is displaceably seated in the groove by means of the base section 25.1.

In a manner corresponding to the sliding block 25, the groove insert 26 in Fig. 4 b) also has base section 26.1, T-shaped in cross section and matched to the groove cross section, as well as a top section 26.2 projecting from the groove, but is embodied longer in the groove direction than the sliding block 25 and is additionally provided with a fastening section 26.4, which protrudes transversely to the groove direction and is spaced apart from the mounting level in the inserted state. Threaded bores 26.3 and 26.5 have been cut in the direction of the normal line from above into its two end sections, as well as into the fastening section 26.4.

As Fig. 4 c) shows, the holding strip 27 is embodied in an angular shape in cross section and has a number of bores 27.1 in its one leg, at least some of which can also be embodied as threaded bores. The bridge 28 represented in Fig. 4 d) is also embodied in an angular shape in cross section and also has a number of bores which can be designed as threaded bores. Furthermore, open slits 28.2, open toward the ends, have been cut in the leg without the bores 28.1 on both sides parallel with the longitudinal extension.

As Figs. 5, 6 and 7 show, the angular strips 27 are somewhat longer than the distance between the two grooves 20, 22 extending in the vicinity of the two longitudinal edges, and they can be selectively fastened in appropriate positions on sliding blocks 25, or groove inserts 26, by insertion into the grooves 20, 22 by means of the introduction of screws 33 through the respective bores 27.1 of the holding strip 27 and can be tightly screwed into threaded bores 25.3 or 26.3, wherein the side of the holding strip 27 with the bores 27.1 preferably constitutes the top side. The holding strips 27

can be displaced in this way in the longitudinal direction of the mounting plate 10 or the mounting level in order to arrange the component 12 in the desired linear position on the mounting level. A base part 12.1 of the component 12 can here be fixed in place by means of the facing fastening section 26.4 of a groove insert 26 in that an attachment screw is turned through the threaded bore 26.5 in the fastening section 26.4 for pressing the component 12 against the mounting level, by means of which furthermore a good contact for removing waste heat results.

At least one bridge 28 can be arranged in a desired position in the transverse direction of the mounting plate 10 between two holding strips 27, and is displaceable in the transverse direction along the holding strips 27 by means of the slits 28.2. In this case the leg of the bridge 28 provided with bores 28.1 is farther spaced apart from the mounting level than the dimension of the respective base part 12.1 of the component 12 in the direction of the normal line of the mounting level, so that the base part 12.1 can be pushed under the bridge 28 and fastened by means of turning in attachment screws through the bores 28.1. Threaded pins, for example, can be used as attachment screws 34.

Several options exist for fixing the component 12 in place on the mounting plate 10, namely, for example, clamping the base part 12.1 on one side by means of at least one groove insert 26 under its fastening section 24.6 on the one side, and clamping in place by means of a bridge 28 on the other side, or clamping the base part 12.1 on both sides of the component 12 by means of respective bridges 28. Components 12 of different dimensions can be attached in different positions in the x/y direction of the mounting

plate 10 by means of several holding strips 27 and bridges 28 and, if required, groove inserts 26, so that the components can be positioned in a simple manner at suitable unoccupied locations, for example inside a housing receiving the mounting plates 10. In the course of fastening in place, the angle-shaped cross section of the holding strip 27 and the bridge 28 results in increased stability. A similar stability effect can also be achieved with a T-shaped cross section, or at least one reinforcement rib.